RURAL INLAND WATERWAYS ECONOMIC IMPACT KIT

ANALYSIS MANUAL

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The primary objective of the project was to develop a PC-based Kit allowing users to evaluate the economic impact of existing rural inland waterways ports and terminals. By using the Kit the importance to a community of a port and terminals can be quantified. The Kit is designed so that users can follow a step-by-step procedure focusing on the economic impact of the totality of a port or terminal operation and linkage to the community's industrial structures and transportation systems. The origin of the design is Maritime Administration Port Economic Impact Kit developed in the 1970s.

Two documents accompany the Rural Inland Waterways Kit. A User Guide has been prepared to guide the user through the operation of the Kit. By following the step-by-step procedures in the Guide, the user is led through an economic impact analysis of the various activities at a port or terminal. An Analysis Manual has also been prepared to assist the user. The Analysis Manual focuses on the details and processes that will be necessary when using the Kit to perform an economic impact analysis of a port or terminal. Included in the discussion are data collection requirements, methodology issues, and the interpretation of the findings.

Several people and institutions provided valuable support to this project. David Rasmussen preformed the computer programming tasks and the industrial classification details. Xiaogin Zeng a graduate student assistant, worked on data collection. Appreciation is expressed to the Planning and Research Division of the Arkansas Highway and Transportation Department for initiating and supporting for the project.

Last but certainly not least, I am grateful to the Mack-Blackwell National Rural Transportation Study Center at the University of Arkansas for their financial support.

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CHAPTER 1

1.0 OVERVIEW OF THE KIT

1.1 Purpose and Scope of Work

Many communities and governmental agencies need an effective method to evaluate the economic impacts of inland waterway ports and terminals in rural areas. Often participants who are responsible for such studies are hard pressed to do such a study. Many lack the expertise, financial support, and the time necessary to do the detailed data surveys and calculations required for an accurate assessment of the economic impacts. Participants need tools that simplify and standardize the analysis, and yet the tools must retain a theoretically acceptable methodology and an adequate economic database quality.

During the project a PC-based Kit was developed to give a user such a tool. This Kit allows a user to evaluate the economic impacts of an existing river port or terminal, a new port or terminal, or an expansion of facilities. Specifically, the Kit is designed to access the economic impact of small and medium size ports and terminals on the inland waterways. By using the Kit and accompanying manual, users are guided through data collection, analysis, and the report preparation steps that are necessary to perform an economic impact analysis.

As a result of this project several task were accomplished including

1. Designing a systematic procedural interface that lets users of the port Kit define a scenario for analysis, input data about the activities, the area economy, and modes of transportation. The types of scenarios users are able to analyze include the impacts of cargo flows, capital spending projects, and

the economic impacts of industries that use a port and terminal facilities extensively.

2. Designing an economic model that allocates the economic impacts of the activities at ports or terminals to industries within the economy of the study area. At the core of the Kit there is an economic input-output model that enables a Kit user to perform an economic impact analysis using an input-output methodology. As a result of this analysis, estimates of a port or terminal economic impact on a study area's levels of output, employment, personal income, and indirect business taxes are computed.
3. Designing a report summarizing the results of the impact analysis. The report generated by the Kit contains estimates of the direct, indirect, induced impacts of the user selected activities, and summaries of the findings of the analysis.

1.2 Terminology of the Kit

Throughout the Kit and documentation, several terms are used repetitively. To eliminate any possible misunderstanding, the following terms are defined explicitly:

1.2.1 Ports and Terminals: A port is a geographical place with a harbor where cargoes can be loaded and unloaded. A terminal is where at least two transportation modes meet, and is the place where a cargoes are switched from one mode of transportation to another. In regards to the Kit, a port is a place with a harbor and multiple port facilities such as multiple terminals, industrial parks, warehousing, and administration facilities. A terminal is at a terminus of a transportation line that provides access to the inland waterways. There may be limited shoreside facilities at a terminal, but its primary

function is access to the waterways. Ports are composed of terminals, but a terminal does not have to be part of a port.

1.2.2 Output: Total gross output is the value of all transactions involved in producing goods and services in a given year. Industry output refers to the value of all interindustry and intra industry transactions involved in producing an industry's products or services.

1.2.3 Employee Compensation: Amount of payroll paid by an industry to its employees.

1.2.4 Indirect Business Tax: Excise taxes, property taxes, fees, licenses, and sales taxes paid by businesses.

1.2.5 Employment: Number of workers employed in an industry on a full-time equivalence basis.

1.3 The Kit's Economic Impact Methodology

This Kit breaks the analysis of the economic impact of ports and terminals into several sequential steps. Figure 1.1 is a schematic diagram of the Kit and the steps involved in a economic impact analysis.

1.3.1 Regional Data Input: The first step in the analysis is to define the study area and input the regional data. In this step, the user must select a level of industrial aggregation corresponding to codes found in the 1-digit, 2-digit, or 3-digit standard industrial classification system (SIC). Next, the user must choose to regionalize the Kit's national model or utilize a national model. The regionalization option allows a user to define a study area or default to a national model. Defaulting to a national model causes national average values to be used in the input-output analysis. When a user

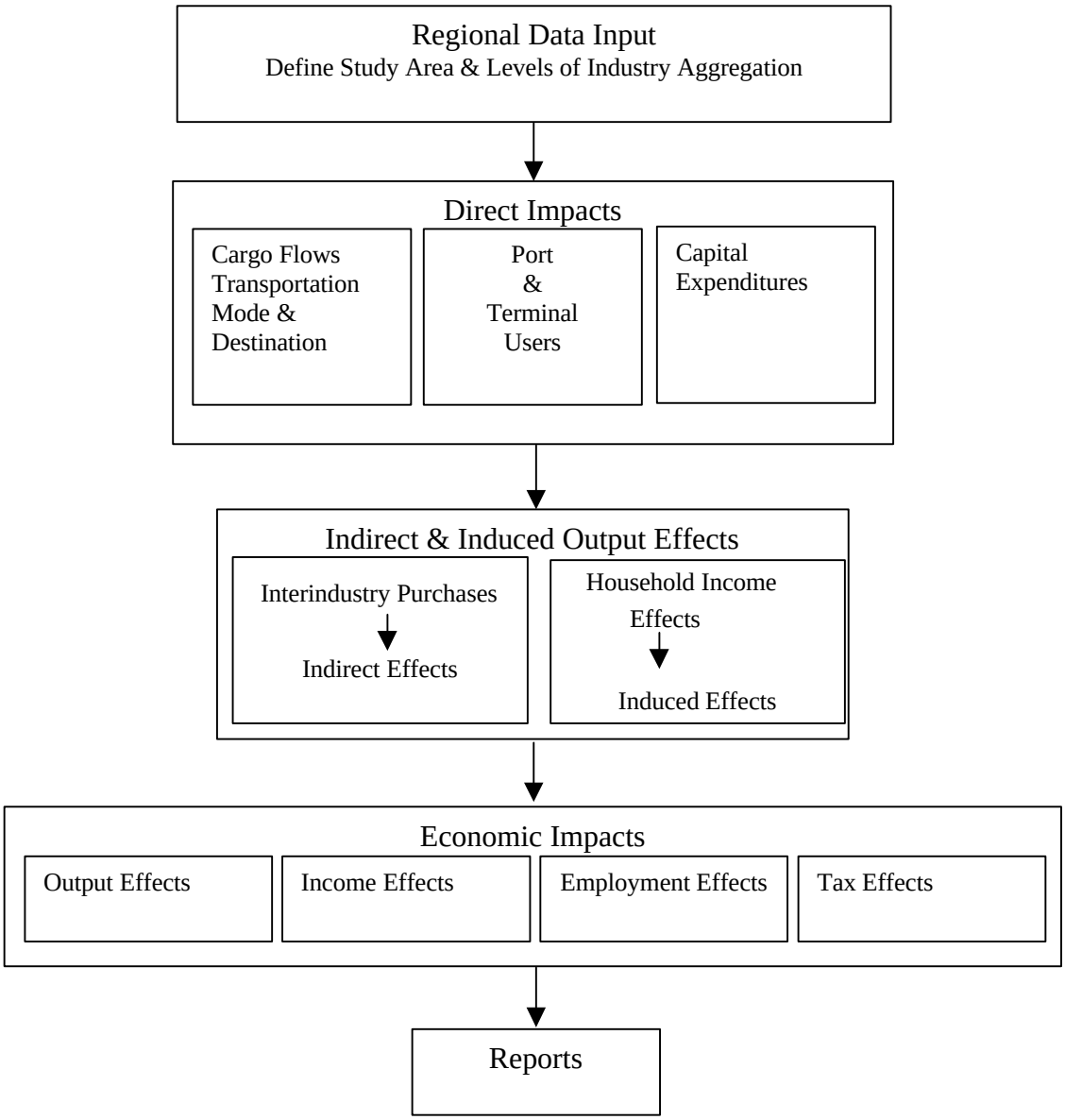

Figure 1.1

Chart of the Kit

opts to define a study area, the user is regionalizing the Kit's underlying national model; this requires the user to enter employment and income data about the chosen study area.

1.3.2 Direct Impacts: The direct impacts are the dollar values of the primary economic activities of a port or terminal. For the purpose of the Kit, primary activities include the

movement of cargoes, the economic activities associated with industries that utilize the services of a port or terminal, and the capital spending associated with expansions and improvements. The Kit has the capability to account for different transportation modes. To estimate the economic impact of cargo flows by transportation mode, users need to identify the transportation mode, input by transportation mode the volume of cargoes transported, the unit cost of transportation, and the average distance traveled.

1.3.3 Indirect and Induced Output Effects: The primary economic activities create demands for products and services of other industries. The act of satisfying these new demands generates interindustry expenditures by industries that supply intermediate resources and other types of raw materials for the primary activities. The effect by which the primary expenditures create the additional outputs is called the indirect output effect. The dollar value of the indirect output effect is the indirect outputs. In addition, households that supply labor services for the direct and indirect activities earn additional income. This additional income supports additional household consumption that creates further economic activity and is called the household income effect. The dollar value associated with the household income effect is the induced output effect of the primary activities and interindustry expenditures. Input-output analysis is a widely accepted method of estimating economic multipliers that measure the indirect and induced output effects.

1.3.4 Economic Impacts: To estimate the total economic impact in the study area of a port or terminal activities using the Kit, the user inputs the direct impacts of a port or terminal. These direct impacts are the dollar values associated with the cargo flows activities, port users activities, and capital expenditures at the port or terminal. For each

activity, the Kit allocates the dollar value of the direct impacts to industries within the region to determine the interindustry expenditures. This allocation of the direct expenditures is according to the production functions derived from the input-output model contained within the Kit. The interindustry expenditures are them multiplied by the appropriate economic multiplier derived from the input-output model to estimate the indirect and induced output effects. Once the output effects are estimated, they are used to derive estimates of their impacts on employee compensation, employment levels, and indirect business tax receipts.

1.3.5 Report: The Kit's findings from the input-output analysis are presented in reports. Both detailed and condensed reports which summarize the findings of the impact study are generated by the Kit.

1.4 Organization of the Manual

The manual discusses the various steps users must go though in order to utilize the Kit. The discussion is general and focuses on the methodological issues and overviews. For a detailed discussion of the actual operating procedures of the Kit, the reader is referred to the accompanying *User's Guide*. The second chapter of the manual addresses the necessary preparation to embark on an economic impact study. The third chapter discusses cargo flows and the process for estimating their direct impacts. The fourth chapter develops issues concerning estimating the direct impacts of port users. The focus of the fifth chapter is the measurement of the direct impact of capital expenditures and improvements at ports and terminals. The final chapter discusses report preparation.

CHAPTER 2

2.0 ECONOMIC IMPACT STUDY: USER PREPARATION

Preparation is the key to a successful economic impact study of a port or terminal. No matter how good the methodology in this Kit, the model relies on accurate inputs from the user. If user inputs are inappropriate, inaccurate, or simply incorrect values, the resulting estimates of economic impacts will have little relationship to the true situation. Appropriate preparation requires the user to follow a series of steps to design an economic impact study. Included in these steps are (1) defining both a purpose for the study and identifying the intended audience of the study, (2) selecting a study area and base period, (3) identifying the appropriate and accurate data sources, (4) developing a method to collect data and collecting the data, and (5) determining the resource requirements for a study. This chapter discusses these preparatory steps.

2.1 Purpose and Intended Audience of an Economic Impact Study

Economic impact studies are designed to produce quantitative estimates of the effects of certain activities or stimuli on a study area. In the case of this Kit, the quantitative estimates are concerned with the activities associated with the operations of a port or terminal; the benefits derived to users of the port or terminal, and the activities associated with constructing, improving, or expanding a port or terminal. Hence, there are two basic purposes for the use of this Kit:

1. To evaluate the ongoing impacts associated with the existence of current facilities. This evaluation can also be extended to include the value projected future activities of a facility.
2. To evaluate the impacts of a new facility or expansion at an existing facility.

The scope of the Kit's economic impact study is in part determined by the choice of activities to include in the study. The intended audience of the study is also an important consideration in determining the purpose, the scope, and the design of the study. In general, the audiences interested in the economic impacts of port and terminals on the inland waterways include the following

1. Waterway users, industries
2. Public agencies, legislators, voters, and the general public
3. Decision-making bodies and investors

2.2 Design of Study

After establishing the purpose of an economic impact study and determining the intended audience of the economic impact report, the next steps are to (1) define a study area and base year, (2) define and measure the types of impacts to include in the study, and (3) identify the data requirements, sources, and collection methods.

2.2.1 Define the Study Area and Base Year: Strictly speaking, the study area should include a geographical area sufficiently large enough to capture the majority of the impacts from port and terminal activities. Typically, a study area corresponds to the labor market that services the port or terminal and local port users. Another possible definition for a study area is the area included in the tax-base jurisdiction. The choice of the study area may also depend on the expected audience of the report. A single county may suffice as a study area if the impact study is for a county or city funded port. Multicounty areas would be appropriate regional waterway authorities. A state might be appropriate for assessing the impact of a facility on the entire state.

It is very important to be aware of a major assumption in this Kit. The Kit is intended for use by rural inland waterway ports and terminals, that is, ports and terminal that have very little impact on economic activity outside their immediate region. It is assumed that activity at the port or terminals is relatively small compared to those activities at a national or global level. In effect, this assumption means that if an existing port or terminal ceased to exist, it would have regional repercussions but no national or global repercussions. For many ports, the Port of New Orleans for example, it would be inappropriate to use this Kit since the economic impacts of large ports go far beyond the immediate New Orleans area and have national and even global ramifications.

The study area definition establishes the data requirements for the impact study. Based upon employment and income data inputted for both the study area and the nation, the Kit regionalizes a national input-output model and constructs an input-output model of the study area. `

2.3 The Default Values of the Kit

The base year for the Kit is 1992. This year is the current benchmark year for the national input-output tables that are used extensively in developing the Kit's input-output model.[1] If users opt not to enter any data, then they must choose a national model and 1992 as the base year. An alternative base year requires the user to enter employment and income data for either the study area or the nation, depending on their selection of a regional or national model. In the case of a national model other than 1992 base year,

[1] U.S. Department of Commerce. Benchmark Input-Output Accounts for the U.S. Economy, 1992. *Survey of Current Business*, November 1997, Volume 77, Number 11, pp. 36-82.
U.S. Department of Commerce. Benchmark Input-Output Accounts for the U.S. Economy, 1992. *Survey of Current Business*, December 1997, Volume 77, Number 12, pp. 22-47.

users must input employment and payroll data for the nation. Obviously, if data from 1992 are not used, a year for which all data are obtainable should be selected.

The user need not define a study area. By not choosing a study area and using 1992 as a base year, a user defaults to this 1992 national input-output model contained in the Kit. In which case, the Kit's impact calculations are based on national averages.

2.3.1 Definitions of Types of Impacts: When cargo moves inbound to a community or outbound from a community, several interrelated economic activities occur. Freight movement necessitates the purchase of labor and transportation services. For example, cargo lifting/hauling between barge and rail requires labor, resources for transport, and might include packaging and warehousing services. Moving cargo by railroad to a manufacturing concern requires more labor and transportation services. At the manufacturing concern, the cargo might be combined with other materials to make yet another product that is shipped and sold in the community or exported from the community. In sum, the movement of cargo results in a series of activities and transactions that enhance interindustry purchases, income, and employment levels in the community. In addition to the cargo flows, there are other economic activities associated with capital expenditures to expand and improve facilities at a port or terminal. The purpose of an economic impact analysis is to quantify the economic value of all activities directly and indirectly related to the cargo movement and investment to support that movement.

In this port and terminal economic impact analysis, three types of impacts are estimated

1. Direct Impacts: The direct impacts are the revenues earned from the movement of cargo through a port or terminal, the additional revenues earned by industries that utilize a port or terminal, and the capital expenditures made by a port or terminal.
2. Indirect Impacts: Industries that supply resources to support the activities associated with the direct impacts of a port or terminal must also purchase additional resources from other industries which in turn must also purchase additional amounts of resources. These interindustry purchases continue until all industries in the community have altered their production and purchase of resources sufficiently to meet the requirements of the community. The indirect impact of a port or terminal is the total value of all these interindustry purchases. This rippling of activity is commonly referred to as a "multiplier effect." Strictly, in terms of input-output terminology, this is a Type I multiplier effect.
3. Induced Impacts: As the levels of economic activity change in the various industries effected by the direct and indirect impacts, earnings of households supplying labor services to these industries will also change. As households spend some of these additional earnings, their purchases generate additional interindustry purchases creating induced impacts. When the induced impacts are added to the indirect impacts, the multiplier effect is referred to as a Type II multiplier.

2.3.2 Measurement of the Direct Impacts: A study of the economic impact of a port or a terminal requires the user to develop estimates of the direct impacts. That is, the direct impacts of the port industries, the port users, and capital expenditures. Port industries are those industries associated with the handling and movement of cargo through a port facility or a terminal. The direct impact of these industries is measured by the revenues received (or expenditures made) from moving the cargoes. The techniques to estimate these impacts is the topic for Chapter 3. In this Kit, port users are industries that are directly linked to the port or terminal by the cargo flows. Port users are partially or wholly dependent on the presence of the port or terminal to receive and ship products and materials. Although the extent of this dependence can be difficult to measure, what is important is the proportion of revenues (or sales) attributed to the port users' utilization of a port or a terminal. Techniques for measuring port users' direct impacts are discussed in Chapter 4. Capital spending for new facilities and improvements to existing facilities is another category of direct impact. Often the direct impact of this type of activity is the cost of the construction project. A discussion of the techquies used to estimate the direct impacts of capital spending are found in Chapter 5.

2.3.3 Measurement of the Indirect and Induced Impacts: The economic impact multipliers derived from the Kit's input-output model enable estimation of the indirect and induced impacts of each group of direct activities. The Kit then uses these estimates to evaluate the impacts in the study area of the activities at the port or terminal on employment, payrolls, and indirect business taxes. Appendix I explains the model's derivation for the indirect and induced impacts.

2.4 Data Collection

The design of impact studies can range from those based on extensive surveys at one extreme to nonsurvey estimating procedures at the other extreme. The goals of an extensive survey approach are to identify and measure, through surveys, the economic impacts in the study that are area associated with the activities at a port and terminal. In this approach, those involved with direct activities must be identified and the details of the activity collected. At the most detailed level, surveys could be utilized to gather the necessary information to develop an input-output model for the study area. In a design that relies on nonsurvey techniques, standardized values and estimates of the value of port and terminal activities are substituted for the survey estimates. A mixed approach relying on both survey and estimation techniques is also possible.

The Kit requires users to collect data on the direct activities of the port or terminal. With regards to developing an input-output model for the study area, the Kit's framework is sufficiently flexible to allow for either a survey or nonsurvey approach. In a nonsurvey approach, the Kit has standardized values based upon national averages. Users can choose to use the standardized national values or they can modify the values by a regionalization process contained within the Kit. Detailed studies driven by surveys are also possible. At the most detailed level, surveys can produce data to define a study area's economic structure, identify port users and the extent to which they utilize a port or terminal facility. The design steps for a specific approach are discussed in the chapters that follow.

2.5 Resources

The resources that are necessary to undertake an economic impact study depend on the approach chosen by the user. This Kit is designed especially for a person or group of people with limited expertise and budgets who want to conduct an impact study in-house. The major resource cost involved in an impact study will be personnel, computer equipment, and data collection costs.

2.5.1 Personnel*:* The Kit is designed for people with limited expertise in economics and planning, but it is also useful a tool for experts. A step-by-by procedure for using the Kit is provided in a user's guide. The challenge for a user is the preparation and organization of the required data for the Kit. The extent of this difficulty depends on the study's level of detail. A more detailed impact study and the greater reliance on survey data increase the complexity of a study. This can create a greater need for expert personnel. When in-house capabilities need to be supplemented with outside expertise, local universities or consultants can be of assistance in the process.

2.5.2 Equipment: A Windows 95 compatible personal computer is required to run the Kit. The more memory available, the better the program runs. The program has run successfully on a 133MHZ PC with 32MB memory. The minimum amount of storage required is around 10MB. The storage requirement is also sensitive to the size of the user database created when a study area is defined. No particular software except a Windows operating system is required to run the Kit. The installation procedure allows the user to install all necessary programs to operate the Kit.

2.5.3 Data Collection Costs: As already noted, data collection can be the most costly aspect of an impact project. Data cost for the Port Kit depends on these factors:

1. Study area definition: As noted earlier, the data defining a study area are available from several sources. The Kit has been designed particularly for use with the *County Business Patterns*.[2] A major hurdle to overcome in using this database will be problems of disclosure and missing data. Estimation, when possible, of the missing data can be costly and time consuming. These topic and estimation techniques are discussed further in Chapter 3. However, in general, the larger the study area and the more aggregated the industrial sectors, the more abundant the data and the less resources that need to be committed to data collection.

2. Level of industrial aggregation used in a study: The more industry detailed (3-digit SIC industries require more detail than 2-digit SIC industries which require more detail than 1-digit SIC industries) required for an analysis the greater data collection problems and costs. There is a trade-off between the gain in precision in the estimation of the economic impacts from using detailed industry data and the additional cost and time in developing a detailed industry database.

3. Methods used to gather data about port industries and port users: Either a survey-based approach or an estimation-based approach can obtain this data. A survey-based approach is more costly than an estimation-approach, but again there is the trade-off between accuracy of the data and the cost to obtain

the accuracy. A survey-based approach will likely need to be done by outside experts who design and administer a survey and then compile and analyze the results.

2.6 Defining the Study Area and Regional Data Input Subroutine

Once the study area is defined, the level of industrial aggregation determined, and data collected, it is time to input this information into the Kit, and construct the study area's input-output model. The Kit enables the user to build a study area input-output model based on inputs from the two data entry subroutines. In addition, the Kit provides an opportunity for the user to define the critical parameters for the study area and input appropriate regional and national employment and income data.

Figure 1.2 shows a chart of the data entry and model construction subroutines. A study area is defined by inputting a level of industrial aggregation, the base year, and the state containing the study area. A multiple state study area can be added to the study area database. A multiple state area requires compiling and entering multiple state area tax rates. The regional data input subroutine requires the user to enter the employment and payroll data for the study area and the nation that corresponds to the selected level of industry aggregation. Once these preliminaries are accomplished, the Kit calculates regional purchase coefficients (RPC) for each industry. The RPC is an estimate of the amount of industry purchases made within the study area. That is, for each dollar of an industry's output demanded in the study area, the RPC is the fraction of the industry output supplied by the study area's industries. The RPC are used to regionalize the national input-output model to derive a study area's input-output model. The Kit displays

[2] At the time this document was written, the U.S. Census, Country Business Patterns web site was: http://www.census.gov/epcd/cbp/view/cbpview.html.

the industries' production functions derived in constructing the study areas' input-output model. For a full discussion and the specific details of regional input subroutines, the reader is referred to the accompanying *User Manual*.

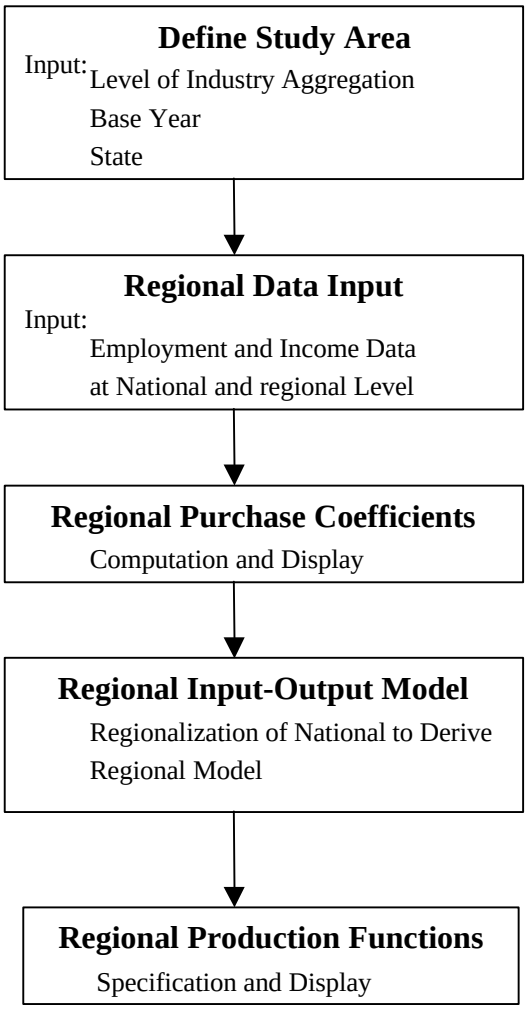

Figure 1.2

Chart for Study Area and Input-Output Model

CHAPTER 3

3.0 DIRECT IMPACTS OF CARGO FLOWS AND TRANSPORTATION

This chapter outlines the methodology for determining the direct impacts of the inbound and outbound cargo flows that move through the port or terminal facilities. The Kit uses three steps to estimate the direct impact of cargo flows. The first step computes the revenues that are created from stevedoring and storing cargoes. The second step determines the expenditures by transportation mode associated with moving the cargoes about the port or around the terminal. The third step estimates the inland transportation expenditures, by mode associated with inbound and outbound movement of cargoes within the study area.

3.1 Cargo Flow Model: A General Approach

For the purpose of constructing a model to analyze cargo flows, inland ports and terminals are viewed as intermodal transportation facilities concerned with handling and transferring waterborne commerce. Figure 3.1 is a schematic diagram of such a transportation system that represents the basis for the Kit's cargo flow design. The diagram shows an internal port area, the study area, and the hinterlands. Merging at the port or terminal are three distinct modes of transportation that include a waterway, a railway, and a truck route. Located along the transportation routes are port users who ship and receive cargoes via this intermodal transportation system.[3]

[3] Pipelines are a fourth transportation mode for some types of cargoes. In the construction of the model, the decision was made to consider pipeline activities as a port user activity and let users account for this activity in the port user subroutine.

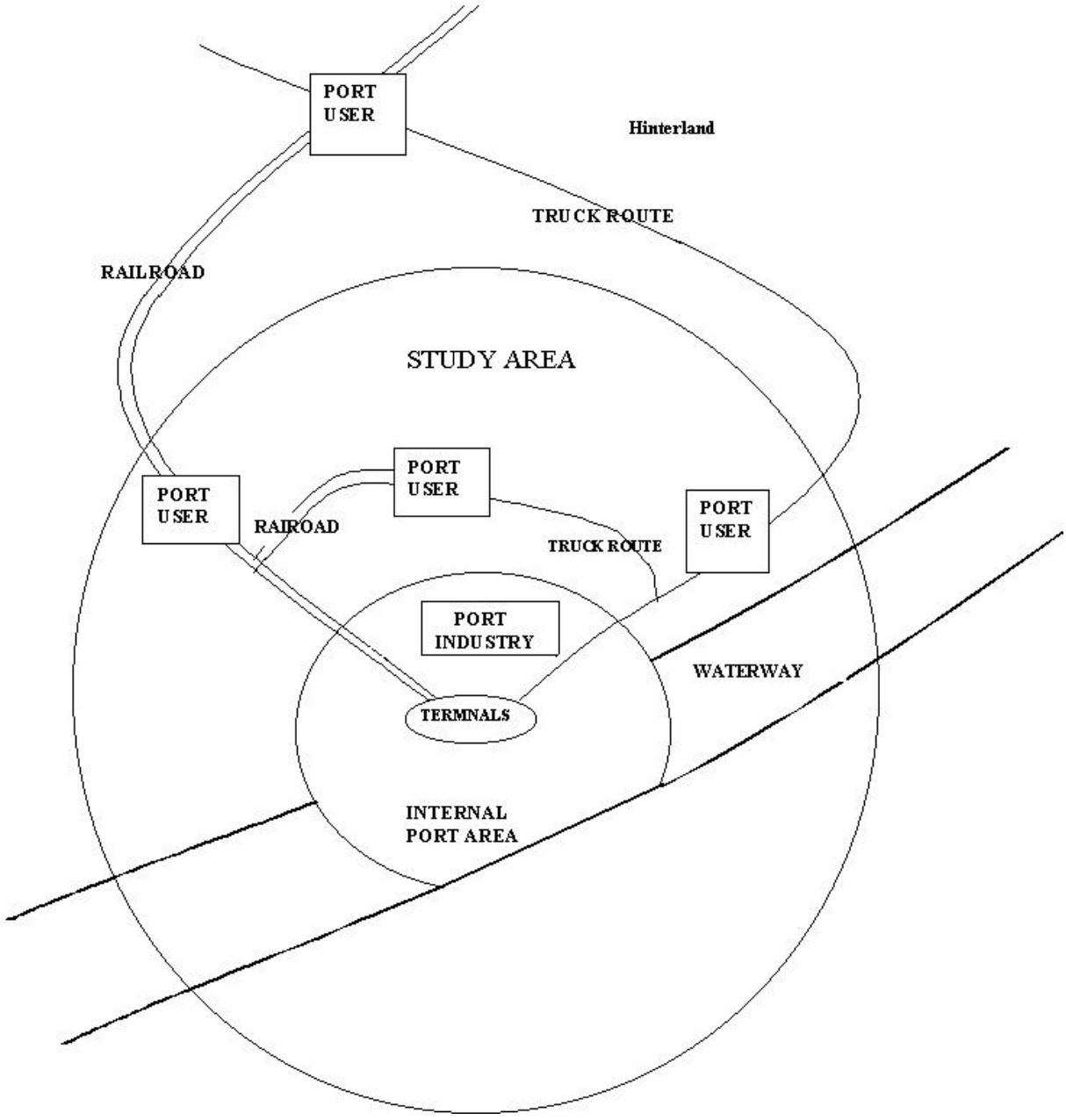

Figure 3.1

Transportation Network for Cargo Flows

Figure 3.1 shows the possibility for freight movements in the internal port area. Internal cargo flows are freight movements by rail, truck, and barge to local port industries.

Included in internal cargo flows are the freight movements into or out of storage within the port. The internal port area is the geographic area that incorporates the internal cargo flows. For the purpose of the model, internal freight transportation is a fixed rate per unit by freight type. The model assumes that a single rate per unit by commodity type is charged for lifting, hauling, and storage of freight within the internal port area. The basis of the Kit computation for the direct expenditures for internal transportation is

Direct Expenditure for Internal Transportation by Mode and by Freight Type =

(Units moved by mode) x (Dollar rate per unit by mode by commodity type)

Figure 3.1 also shows port users located in both the study area and hinterlands. Inland transportation refers to freight shipments to these port users. Inland freight movements include cargoes within the study area but outside the internal port area, and freight shipments outside the study area. In the Kit, revenues from inland transportation depend on the cargo type, transportation mode, and distance shipped. The economic impact of the direct inland transportation expenditures in the study area depends on the percent of the expenditures made in the study area. The basis of the Kit's computation of the direct expenditure for inland transportation is

Direct Expenditure for Inland Transportation =

(Units moved by mode) x (Dollar rate per unit mile by mode) x (Average miles hauled by mode) x (Percentage of expenditure in study area).

3.2 Estimating the Economic Impact of Cargo Flows: Overview

Figure 3.2 is a chart of the steps involved in determining the economic impact of cargo flows described in the previous section. There is a choice between internal

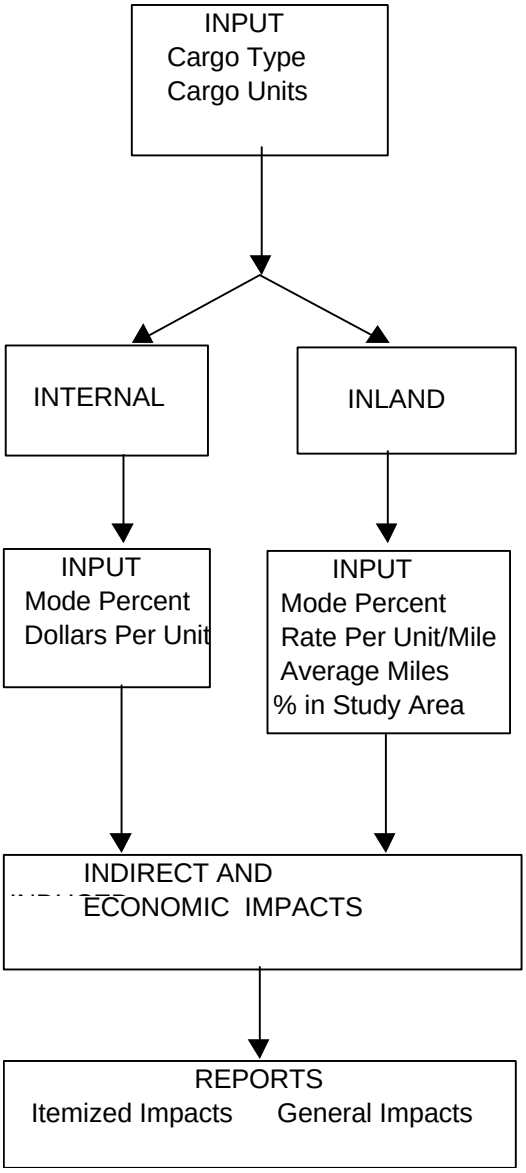

Figure 3.2

Chart of Cargo Flow Transportation Mode and Distinction

and inland transportation for each cargo type. For internal cargo flows, or site cargo flows, and for each cargo type transported on site, the percent moved by rail, truck, barge, and the dollars per unit (revenues per unit) earned from transporting, handling, and storage by mode must be entered into the Kit. For inland transportation of a cargo, the

Kit's inputs are the percent shipped by mode, the average miles shipped, the rate per unit/mile, and the percent of the inland transportation expenditure within the study area. When all necessary values are entered, the Kit calculates the economic impacts of the cargo flows by type of cargo and creates both an itemized report by cargo type and a general report totaling all cargo type impacts.

To do the cargo flows computations, the Kit requires users to enter several critical values, including percent of cargo flows by transportation mode, dollar value per unit of cargo, transportation rate per mile by mode, and the percent of inland transportation expenditure within the study area. The direct impacts of these activities and their estimates are focal points of economic impact analysis. Table I displays several estimates of per ton mile rates by transport mode and the capacity of each mode. As noted in the table, these rate estimates have been obtained from various sources and are provided only as guidelines. Rates can be expected to vary across regions, between peak and off peak seasons, and because of local tax effects and a multitude of other reasons.

Table I

Transportation Modes Capacity and Rates

Transportation Mode	Capacity[b]	Rates
Barge	1,500 Tons 52,500 Bushels 453,600 Gallons	$0.097 per ton mile
Jumbo Hopper Car	100 Tons 3,500 Bushels 30,240 Gallons	$0.0253 per ton mile[a]
Large Semi-Truck	26 Tons 910 Bushels 7,865 Gallons	$0.0553 per ton mile[a]

a. National Transportation Statistics, US. Department of Transportation, and Public Display by U.S. Corps of Engineers.
b. Iowa Department of Transportation, 800 Lincoln Way, IA.

3.3 Direct Impact Estimates of Cargoes: Dollars Per Unit

An accurate estimation of the dollars per unit is critical to a successful impact study. But, exactly what unit does the model require? In the Kit, units refer to standardized measures with regard to the movement of a cargo. Hence, units could be long tons of a cargo, short tons, metric tons, etc. Units can also refer to rail cars or containers, etc., when this is a basic unit that defines the cargo type. The Kit can use the number of rail cars or containers shipped as a basic cargo flow activity. From the port or terminal operator's view, dollars per unit are the revenues per unit earned from cargo operations. From the viewpoint of a port user, dollars per unit are the expenditures per unit of cargo that are made to obtain port industry services. In order to estimate this dollar value, data must be gathered and prepared. This involves:

1. Cargoes by type: Define the cargo units and obtain the cargo shipment by unit and by type. This can be a historical series or the most recent year amounts. For new facilities, projections of expected future shipments must be made.
2. Revenues and Cost by Cargo by type: Estimates the revenues per unit by cargo type. Alternatively, obtain estimates of direct spending handling/hauling/ storage by cargo type either on a per unit basis or in total.
3. Percentage of Cargo by Mode: Estimate for each cargo type the modal shipment shares by mode— percentage estimate of how much cargo is moved by rail, truck, or barge for both inland and internal freight shipments.
4. Rates by Mode: Estimate the rate per mode by cargo type. For inland cargo flows, the average number of miles a cargo type is shipped, and the average rate

per mile per unit shipped are needed. For cargo flows within the port area, only the rate per mode by cargo type is required.

5. Estimate the Percent of Inland Transportation Expenditure Within the Study Area: For each mode and commodity type, there are transportation expenditures for shipping the freight inland. Some of these expenditures are paid to local shippers (shippers within the study area) while others are paid to shippers outside the study area. These latter payments do not have an economic impact within the study area and must be excluded from the analysis. Hence, the percent of local shipping expenditures to total shipping expenditures is a simple way to estimate the percent of transportation expenditures in the study area by mode and by commodity type.

Generally, this type of information comes from an analysis of activities at the port or terminal. A Kit user may need to collect this data from the major shippers who use the facilities.

There are two ways of estimating dollars per unit. If information on the revenue per appropriate unit is available, then that amount corresponds to dollars per unit. The product of the cargo type units and dollars per unit converts the cargo units into revenue units. An alternative method is to directly estimate expenditures associated with moving the cargo.

Table 2 is an example of the computation necessary to arrive at an estimate of the dollars per unit based upon the expenditures associated with moving the cargo. In this

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TABLE 2

DIRECT EXPENDITURES BY CARGO TYPE: GRAVEL EXAMPLE

Cargo Flows By Mode		Cargo Type				
Type of Cargo	Gravel	Grains	Fertilizers	Petroleum	Aggregates	
Tons Inbound						
Tons Outbound	22,500					
Total Tons Handled	22,500					
Number of Barges	15					
Average Ton Per Barge	1,500					
Port Handling Charges						
Handling Charges Per ton	$ 15.00					
Terminal Charge per ton	$ 1.00					
Subtotal	$ 16.00					
Handling Charges per barge	$ 100.00					
Terminal Charge per barge	$ 10.00					
Subtoal	$ 110.00					
Handling Charges per Barge/Ton Equivalent	$ 0.07					
Subtotal Handling Charges per ton	$16.07333					
Stevedoring Per Unit						
Barge side	$ 5.00					
Shoreside	$ 5.00					
Warehousing	$ 5.00					
Total Stevedoring	$ 15.00					
Subtotal Stevedoring per ton	0.01					
Related Expenditures						
Supplies/Repairs						
per barge	$ 10.00					
per ton						
Frigth Forwarder						
per barge	$ 10.00					
per ton						
Banking and Insurance						
per barge	$ 10.00					
per ton						
Crew Expenses						
per barge	$ 25.00					
per ton						
Administrative Expenses						
per barge	$ 10.00					
per ton						
Other Expenditures						
per barge	$ 10.00					
per ton						
Total related expenditures	$ 75.00					
Subtotal Related Expenditures per ton	0.05					
Direct Expenditures per ton	$ 16.13					

hypothetical example, 15 outbound barges ship 22,500 tons of gravel. The units in this example are tons shipped with the average tons per barge equaling 1,500 tons (22,500/15= 1,500). The three general categories of direct expenditures related to this cargo movement include handling charges, stevedoring charges, and related expenditures. In each category there is a per ton charge and a per barge charge. The direct expenditures per barge are converted into expenditures per ton by dividing the expenditures per barge by tons per barge. The handling charges per barge are converted into a per ton basis (handling charges per barge/tons per barge) and added to the per ton handling charges to determine the handling charges per ton subtotal. Likewise, stevedoring rates per barge are converted into a per ton basis and added to the per ton charges to find the stevedoring charge subtotal. In this example, related expenditures for supplies, freight forwarders, banking and insurance, etc., are in terms of barges, and converted to per ton equivalent and subtotaled to estimate related expenditures per ton. The sum of the subtotals for each expenditure category is the estimate of the direct expenditures to transfer a ton of gravel by barge through the port. Kit users should note that this example attempts to be all inclusive. A port or terminal may or may not incur all these expenditures and must determine only those charges that are appropriate for that facility.

In summary, for each cargo type, the Kit requires dollars per unit by mode. This value can be either on a revenue per unit basis or on expenditures per unit basis as discussed above. Regarding inland transportation, the estimation of the direct impacts require rates per unit-mile, the average distance hauled per mode, and determination of the percent of the transportation expenditures spent within the study area by mode.

CHAPTER 4

4.0 PORT USER IMPACTS

This chapter focuses on the methods for determining the direct impact of port users. The direct impacts of port users are the sales revenue, employment, payrolls, and taxes that the port dependent industries earn because of their association with a port or terminal. Port users are industries that are directly linked to cargo flows; that is, they ship or receive cargoes via a port or terminal. Port users economic dependence on a port or terminal can vary from partial to complete. The decision to include a port user in a study must be given careful consideration as well as appraising their dependence on a port or terminal.

The Kit requires an estimate of the total value of a port users' sales revenues, and an estimate of the proportion of the sales revenues attributed to their association with a port or terminal. Once these two estimates are obtained for each port user, the sales revenues by industry can be aggregated, and the proportion of total industry sales attributed to the port or terminal can be computed. Kit users must enter industry sales revenues and percentage of sales attributed to their association with the port or terminal. Based upon the direct impact of the port user by industry, the Kit computes the indirect and induced economic impacts of port users.

4.1 Economic Impact Computation For Port Users

Figure 4.1 shows a flow chart of the Kit's subroutine that determines the economic impact of port users on the study area. The first step in the port users subroutine is to select an industry to analyze. The level of industrial aggregation

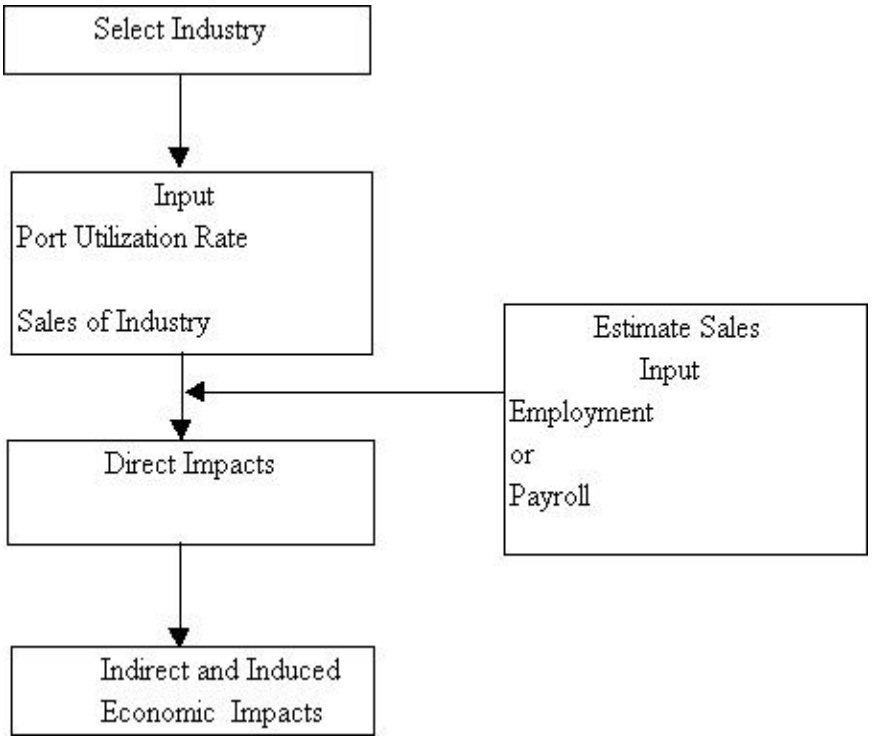


Figure 4.1

Chart for Computation of Port Users Economic Impact

chosen in the design of the study area subroutine determines the selection list. Once an industry is selected, its port utilization rate is entered, this rate is a measure of the fraction of sales the industry can attribute to its relationship to the port or terminal. The next step is to enter the industry sales into the model. If sales figures (revenues) for the industry are not available, the Kit has two subroutines based on employment and payroll that provide estimate industry sales. Once the model has values for the port utilization rate and industry of sales, the direct impact of the industry is calculated as

Direct Impact of a Port User Industry = (Port Utilization Rate)* (Industry Sales).

The direct impact of the industry is then used by the input-output model to determine the indirect and induced impacts of the industry on the study area.

4.2 Identification of Port Users and Direct Impacts

The research task in this section of the model is to identify the industries within the study area that are dependent on the inland waterway for shipping products or receiving inputs. In addition to identifying the industries, users must identify the extent the industry utilizes the inland waterway. Some industries within the study area are port dependent; that is, a major factor in their decision to locate in the study area is the presence of the port or terminal. Without the access to the waterways, the port dependent industry would not be located in the study area. For this type of industry, the total value of the industry activity is linked to the waterways, and therefore, the percent of their activities attributed to the port or terminal is 100%. Other industries in the study area might utilize the waterways because of cost or service advantages, but there are alternative transportation modes and providers of services that could be relied upon in the absence of a port or terminal. In this case, the incremental activity made possible for the industry because of the association with the port or terminal is the appropriate measure of the direct impact.

4.2.1 Export-Oriented Industries: Export-oriented are perhaps the easiest industries to identify. This type of port users ships their products via the port or terminal to markets outside the study area. The value of the products shipped through the port or terminal is a measure of the direct impact of the port users. When an export-oriented firm relies completely on the port or terminal for shipping, the total value of shipments is the direct impact. The total value of the shipments excludes the inland transportation costs which are accounted for in the cargo flow analysis. For other export-oriented firms that only ship a proportion of their products via the port or terminal, it is necessary to determine

what portion of their total shipments transit through the port or terminal. This proportion is the percentage of the export-oriented firm's activities that attribute to the port or terminal.

4.2.2 Import-Oriented Industries: Import-oriented industries utilize the port and terminal services to import various types of commodities into the study area. The direct impacts of this activity are difficult to appraise. According to economic theory, the value of the incremental economic activity directly related to importing the commodities is the appropriate measure of the direct impact. A chief problem in assessing this incremental activity is the possibility of import substitution within the study area. Often commodities imported from outside a study area compete with similar commodities produced locally. These types of imports are called comparable imports. When local production of a commodity is replaced by a comparable import, there is a decline in economic activity within the study area. In this case, the direct impact of the import-oriented industries is a net effect that accounts for importing activity less the impacts on the import completing industries in the study area. Another possibility is for industries using comparable imports as inputs in their production process to actually increase their output. This possibility can happen when a lower price of imported input reduces the cost of production for industries using the imported input, and the cost reduction is then passed on to consumers through a lower price of the product which in turns increase consumption of the product. Therefore, if the comparable import is an input used by a local industry, it is possible for a price effect to actually enhance local industry output. This effect is also part of the incremental activity linked to the direct impact of port users. Because of the complexity of possible direct outcomes and the difficulty of obtaining

appropriate data, it is recommended that unless adequate data are available, that the import-oriented port user industries be excluded from the study. This amounts to the assumption that the net effect on port users of importing comparable imports into the study area is zero. In which case, the direct impacts of this importing activity is actually captured in the cargo flow analysis as freight movements.

Another issue concerning import-oriented port users is the treatment of imported commodities that are consumed locally but not produced locally. These types of imports are called noncomparable imports. The direct impact of noncomparable imports is actually captured in a cargo flow analysis of the port and terminal activities, and including theses commodities in the analysis again would in fact result in double counting. It is recommended that noncomparable imports be excluded from the port users impact analysis.

4.2.3 Alternative Measures of the Direct Impacts: As already noted, the Kit requires the levels of industry sales for the port user industries and the fraction of sales attributed to the port or terminal. The Kit provides two alternative methods for estimating sales based upon either the number of workers (employment) or the payroll. Users can choose to enter either employment or payroll by industry and then have the Kit estimate a corresponding sales level. The Kit estimates of industry sales are based on the national sales per worker and sales to payroll ratios. If the users elect to use this option, they are assuming that the industry sales in the study area are proportional to the national industry.

The formulas used in the two estimating techniques are shown below:

Employment based formula:

Industry Sales =

(Industry Employment) * (Sales Per Employee in National Industry).

Payroll based formula:

Industry sales =

(Industry Payroll)*(Sales to Payroll National Industry).

4.2.4 Alternative Approach for Measuring Direct Impacts: One of the problems that happens in input-output analyses is that the input-output model does not contain industries that match a study area's industry. Yochum and Agarwal (1987) have developed an alternative approach for such a circumstance.[4] They suggest using the industry's payroll and allocating the payroll to the industry groups based on the consumer expenditures by industrial sector. The direct impact of the port user would then be through payroll impacts on consumer expenditures by industry within the study area. The consumer expenditures by industry group are then fed into the Kit via a particular sector. A difficulty with this approach is matching the consumer expenditures by category with the corresponding industry groups, and adequately estimating average expenditure per worker. The basic consumer expenditure data for this approach can be obtained from the Consumer Expenditure Survey Series, Bureau of Labor Statistics.[5]

4.2.5 The Port Utilization Rate: The port utilization rate is the percentage of the port user activities that can be attributed to their association with a port or terminal. In terms

[4]Yochum, Gilbert and Vinod Agawal. Economic Impact of a Port on a Regional Economy: Note. Growth and Change, Summer, 1987, pages 74-87.

[5] Bureau of Labor Statistics, Consumer Expenditure Surveys -- Branch of Information and Analysis. Postal Square Building, Room 3985, 2 Massachusetts Avenue, N.E., Washington, DC 20212-0001

of a port user's sales, the port utilization rate is the ratio of the incremental sales due to the use of the port industries to total sales. Port user's activities (sales) should not include transportation expenditures that have already been captured in the direct impacts of the cargo flows. Again, there are the difficulties and problems with assessing the incremental sales. DeSalvo (1994) has a detailed and theoretical discussion on the measurement of the direct impact of port users.[6]

4.2.6 Surveys

Some type of survey will be required to gather the necessary information about port users. The critical values a survey should concentrate on collecting follow:

1. A measure of the port users' total output. Ideally, this would be the level of sales corresponding to the time period of the study. In lieu of sales, the level of employment or payroll can be used in the Kit to estimate the level of sales.
2. The port users' dependence on the port or terminal.
3. The port users' industrial sectors. The Kit requires port users to be classified by the Standard Industrial Classification Codes (SIC) for 1987.

Surveys can vary from very limited surveys to detailed surveys. A limited survey of local port and terminal users conducted by telephone or a mailing requesting sales, employment, payroll, SIC classification, and port dependence is suitable for small study areas with known port users. For larger study areas or with unknown port users, a mail survey is appropriate. In this case, a mail survey of industries within the study area can identify port users, and follow up questionnaires either by phone or mail to obtain the needed information from the port users.

[6] DeSalvo, Joesph. Measuring the Direct Impacts of a Port, *Transportation Journal*, Vol 33, number 4, Summer 1994, pages 33-42.

Detailed surveys are likely to provide more accurate data if port users are willing to release the data and respond with an adequate response rate. Detailed survey requires time to design the survey questions, conduct an initial survey, and often follow up with telephone interviews to complete inadequate responses. An example of a detailed questionnaire is presented in Appendix II.

To supplement the surveys, secondary sources of information can often be utilized. As already noted, this Kit's design relies on *County Business Pattern* data as a secondary source for payroll and employment data for port user industries.

CHAPTPER 5

5.0 CAPITAL EXPENDITURE IMPACTS

The capital expenditure subroutine is designed to assess the economic impact of construction projects at the port or terminal. In particular, the model evaluates the economic impacts associated with constructing new facilities, remodeling, upgrading, and maintaining existing facilities. Capital expenditure impacts are short-term in nature lasting the period associated with a particular project. In essence, capital expenditure projects are one-time expenditures whose economic impacts are realized only one time.

The Port Kit allocates the capital expenditures according to the specification of the construction industry's production function determined in the regional data input section of the model. There are several important considerations when evaluating the economic impact of capital expenditures using a production function specification based on construction activities. These issues include the local content of the capital expenditures, the treatment of expenditures on capital equipment, and the incremental cargo effects.

5.1 Capital Expenditure Subroutine

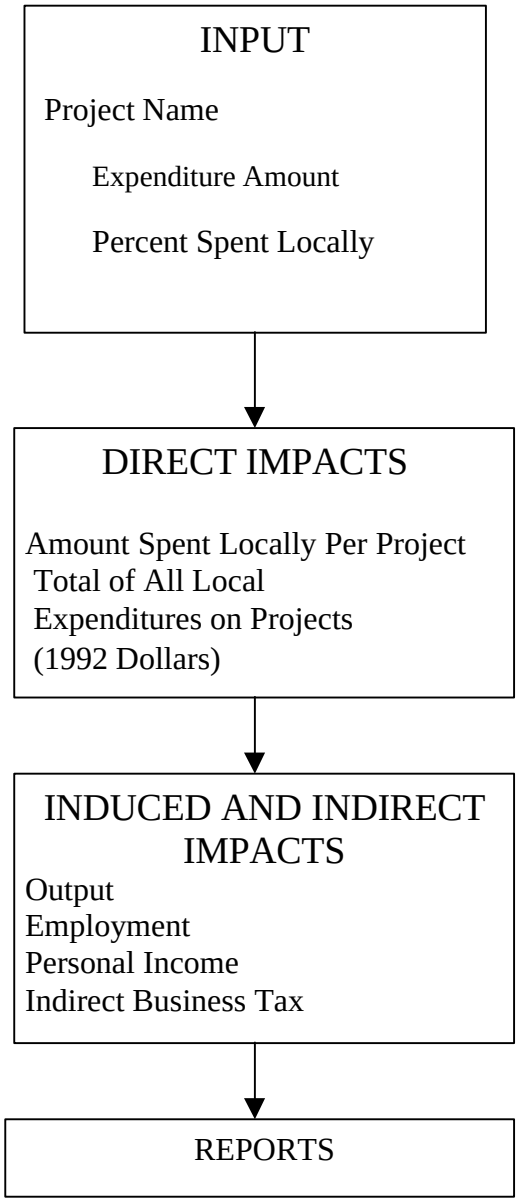
A capital expenditures subroutine flowchart is displayed in Figure 5.1. This subroutine requires three inputs, a name for the project, the dollar amount of the project, and the percent of the expenditures spent locally. The direct impact of the project on the study area and the direct expenditures of the project in the study area are computed as

Direct Impact Capital Expenditures =

(Expenditure amount) * (Percent of Expenditures Spent Locally).

Figure 5.1

Chart of Capital Expenditures Computations



The interindustry purchases necessary to support the direct expenditures are found by allocating the direct expenditures across the industries according to the construction industry's production function that has been specified in the regional data input

subroutine. These estimates are fed into the study area's input-output model to estimate both the indirect and induced output effects. Once the three output effects are calculated, the Kit computes employment, income, and indirect business tax impacts and reports the findings.

The findings from the analysis of capital expenditures are reported in a cumulative format. If each project needs to be analyzed separately, then each previous project must be deleted from the current analysis. This procedure is discussed in the user's guide.

5.2 Local Content Issues

For expenditures to have an economic impact within a study area, they must be made within the study area and remain within the study area. When a regional model is specified, the production function is adjusted by a regional purchase coefficient to account for the interindustry purchases that are made locally as opposed to leaking out of the study area. However, the local content of the initial expenditure is not taken into account. Regarding the construction expenditures, a large proportion of the expenditures may be for materials, equipment, and labor supplied from outside the study, and therefore, these expenditures would not have a local content or a local economic impact. They should be excluded from the impact study.

The model requires the Kit user to estimate the percent of the expenditures that is spent locally. Payrolls that are associated with construction expenditures can be adjusted by the percent of the workers who reside within the study area. The fraction of materials purchased locally should also only be included in the initial expenditure.

5.3 Equipment Expenditures

Capital expenditures for equipment should be separated from capital expenditures for construction activities. It is not appropriate to use construction expenditures to reflect the economic impacts associated with capital expenditures for equipment for several reasons. First, the interindustry expenditures for construction activities and the purchase of some type of equipment are likely to be substantially different, and therefore, their economic impact substantially different. Secondly, it is very likely that the purchase of equipment will be from suppliers outside the study area. In which case, there will be very little direct impact on the study area from the equipment purchased.

An alternative approach to estimate the impact of equipment expenditures is to treat them as additional sales of a port user. By matching the equipment to a port user industry, the port user subroutine can estimate the economic impact on the study area of the equipment purchase. In adopting this approach, the port utilization rate becomes the percent of equipment purchased locally and the sales output of the amount of the equipment expenditure. The product of the port utilization rate and the equipment expenditure estimates the direct impact of the equipment purchased in the study area. The Kit's port user subroutine could then compute the indirect and induced impacts of the equipment expenditures.

CHAPTER 6

6.0 Reports

The final step in an economic impact analysis is to prepare a report. The purpose of the report is to present the findings of the economic impact study and to highlight the role played by the port or terminal in the study area's economy. The focus of a report can vary depending on the report's audience. A very detailed technical report might be appropriate for an audience concerned with the economy of a port or terminal. A brochure might be a preferable presentation method for general audiences. This chapter discusses the key elements of an economic impact report for a port or terminal.

6.1 Summarizing the Economic Impact Findings

The impact analysis focuses on measuring the direct impacts of cargo flows, port user activities, and capital expenditures. These three areas should be the focus of the report.

6.1.1 Cargo Flows: The inbound/outbound cargo flows analyzed in the impact study should be presented and discussed in a report. A time series of historical cargo flows compared to current activities is a useful perspective. Cargo flows can be broken down into commodity type, type of transportation mode, and inbound/outbound distinctions.

6.1.2 Port Users: A description of the port users should be presented in some detail. A description should include a discussion of the direct impacts of the port users and pertinent statistical information concerning sales revenues, payroll, employment, and taxes.

6.1.3 Capital Expenditures: A discussion of the capital expenditure projects, their purpose, and direct impacts on the port or terminal operations should be included in the report.

6.1.4 Total Economic Impacts: For each of the major activities, an essential element of the report should include a presentation of the indirect and induced impacts. Included in this presentation should be the impact on the study area's output, payrolls, employment levels, and amount of indirect business taxes. If appropriate, an aggregate report containing total output of the port or terminal, total employment, total payroll, and total indirect business tax impacts will likely prove very useful in demonstrating the overall importance of the port or terminal.

6.1.5 Presentation: The actual report presentation should include tables and charts to support the written materials. The text output of the Port Kit is transferable to a spreadsheet where it can be used to create tables and graphics for presentation in the report.

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APPENDIX I

DERIVATION OF THE PORT KIT'S INPUT-OUTPUT MODEL

This Appendix focuses on the derivation of the Port Kit's input-output model from the national input-output, and the method that are used to regionalizes the Port Kit's I-O model to more closely match a study area. Also discussed in this Appendix are the techniques that have been developed to derive the estimates of the output effects, employment effects, income effects, and indirect business tax effects.

The Port Kit's basic model is an RIMS II type model developed from the 1992 benchmark accounts for the U.S. economy.[7] The Port Kit basic model and its multipliers are prepared in several steps. First, an adjusted national industry-by-industry direct requirement table is constructed. Secondly, at the option of the user and using inputted data, the national direct requirement table is regionalized. Thirdly, an industry-by-industry total requirement table is prepared, and the regional multipliers are derived from this table.

National Industry-by-Industry Direct Requirements Tables

The BEA's 1992 benchmark I-O accounts for the U.S. economies are constructed around a *use* and a *make* table. The *use* table shows the dollar values, in terms of producer prices, the commodities used by each industry and final users. The identity for the *use* table shows the interindustry purchases of commodities by industry and the final demand sectors:

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[7]. Benchmark Input-Output Accounts for the U.S. Economy, 1992. *Survey of Current Business*, U.S. Department of Commerce November 1997, Volume 77, Number 11, pp. 36-82.
Benchmark Input-Output Accounts for the U.S. Economy, 1992. *Survey of Current Business*, U.S. Department of Commerce, December 1997, Volume 77, Number 12, pp. 22-47.

(1) $Q = Ui + E$

where

Q is a column vector in which each entry shows the total amount of the output of each commodity.

U is a commodity-by-industry matrix in which the column shows for a given industry the amount of each commodity it uses.

i is a unit (summation) column vector containing only l's.

E is a column vector in which each entry shows the total final demand for each commodity.

The identity for the *make* table shows the amounts each industry produces of a given commodity:

(2) $X = Vi + h$

where

X is a column vector in which each entry shows the total amount of each industry's output, including its production of scrap.

V is an industry-by-commodity matrix in which the column shows for a given commodity the amount produced by each industry.

h is a column vector in which each entry shows the total amount of each industry's production of scrap.

The use table is adjusted so that it includes only domestically produced commodities. For this adjustment, commodity imports are subtracted from the commodity total to determine the domestically produced commodities.[8]

Several additional steps are necessary to arrive at a national industry-by-industry direct requirement matrix. A commodity-by-industry direct requirement matrix that shows the dollars worth of each commodity required to produce a dollars worth of each industry output is calculated as:[9]

$$(3) \qquad B = U(X_d^{\wedge})^{-1}$$

where

X_d the entry of this matrix shows the total amount of each industry's domestically produced output. When placed next to a vector, the symbol ^ indicates a square matrix in which the elements of the vector appear on the main diagonal and zeros elsewhere.

An industry-share matrix that shows each industry's share of the production of a commodity is also calculated:

$$(4) \qquad D = V(Q^{\wedge})^{-1}$$

After several substitutions and manipulations, an equation relating the industry output to final commodity demand is obtained:[10]

$$(5) \qquad X_d = W(I - BW)^{-1} E$$

where

[8] The commodity import database is available upon request from the Interindustry Economic Division of the Bureau of Economic Analysis.
[9] The assumption is that inputs are required in proportion to output, and these proportions are the same for primary and secondary products. This is often referred to as the industry technology assumption.
[10] For the computations, the reader is refereed Miller and Blair (1985), pages 149-174.

$W = (I-p\hat{})^{-1}D$ is an industry-by-commodity matrix in which the entries in each column show, for a given commodity, the proportion of the total output of that commodity produced in each industry adjusted for scrap produced by the industry.

p is a column vector in which each entry shows the ratio of the value of scrap produced in each industry to the industry's total output.

$(I - BW)^{-1}$ is the commodity-by-commodity total requirements matrix, giving commodity output required per dollar of each commodity delivered to final users.

$W(I - BW)^{-1}$ is the industry-by-commodity total requirements matrix, giving the industry output required per dollar of each commodity delivered to final users.

I is an identity matrix

Since data available to users are industry specific, it is necessary to convert the equation (5) into the form that relates an industry-by-industry total requirements table so that the model relates the final demand for industry output to the total industry requirements.

Letting Y represent a column vector of final demands for industry output, the proportion of the total production produced by each industry is given by

$$Y = WE$$

or

$$(6) \quad E = W^{-1}Y$$

Substitute of equation (7) into (5), and after some simplification, one arrives at the equation relating the final demand for industry output to the industry total domestic output:

(7) $X_d = (I-WB)^{-1}Y$

or

(8) $X_d = (I-A)^{-1}Y$

where

$A = WB$

The matrix WB is a national direct requirement matrix for an open I-O model.

An open I-O model excludes the household sector, and its dual role as a consumer of industry output and as a supplier of labor inputs to industry. A closed I-O model incorporates the household sector into the direct requirement table by adding a household row to reflect household earnings (payments for labor services) and a household column to reflect household consumption (personal consumption expenditures). The inclusion of a household row and column enables the model to account for induced effects that are a consequence of earnings and expenditure of households. The household row and column are added to the direct requirement matrix before the regionalizing process and the derivation of the total requirement matrix.

Household Row: A household row shows earnings received by households resulting from their contribution to industry output. Generally, household earnings include wage and salary, proprietors' income, director's fees, employer's contribution to health insurance less personal contributions for social insurance.[11] Because of resource limitations of potential users and the difficulty they are likely to find in obtaining data for household earnings, the Port Kit restricted its definition of household earnings to compensation paid employees for their contribution to industry output. The row elements

[11] U.S. Department of Commerce, Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II), March 1997, 3rd Edition.

added to the Direct Requirements Table are the proportion of compensation paid to employees by industry to total compensation paid to employees in all industries. Compensation to employees includes payroll and benefits paid to workers in census covered industries and noncensus covered industries.[12]

Household Column: The household column shows the expenditures of households for industry output. Personal consumption expenditures (PCE) from the national I-O tables is used for the basis of this estimate. According to Miernyk, when a household row and column are moved into the processing sector as they are in this case, the sum of the row entries must equal the sum of the column entries.[13] Because the initial sums for compensation of top employees did not equal the sum of PEC, it became necessary to reconcile the PCE column entries, so that the adjusted PCE column sum matched the employee compensation row sum. In the reconciliation, each PCE proportion to total PCE is weighted by the total compensation to employees to arrive at an adjusted PCE share.[14] The column vector of adjusted PEC shares is then multiplied by the industry-shares matrix to yield the adjusted PCE shares by I-O by industry.

Direct Requirements Table for the Closed Model: The closed models' direct requirements table was constructed by adding a household column and a household row

[12] U.S. Department of Commerce, Benchmark Input-Output Accounts for the U.S. Economy, 1992. *Survey of Current Business 77*, no. 11 and no. 12, November (1997) and December (1997).
[13] Miernyk, William, *The Elements of Input-Output Analysis*. Random House, New York, 1996.
[14] Let PCE_i be the personal consumption expenditures in i^{th} industry, and PCE be total personal consumption expenditures. Also, let EC_i be employee compensation in the ith industry, and EC be total employee compensation. The computation to for adjusted PCE (APCE) is:

$$APCE_i = (PCE_i)/PCE*EC.$$

Note that $\sum APCE_i = \sum (PCE_i)/PCE*EC = EC.$

discussed above, to the WB matrix. The resultant matrix is a given by:

$$(9) \quad A' = \begin{array}{|c|c|} \hline WB & HHc \\ \hline HHr & 0 \\ \hline \end{array}$$

National Total Requirements Table

To derive a national total requirements matrix, equation (8) is modified so that the open direct requirement table is replaced by the closed direct requirements table. Equation (8) then becomes

$$(10) \quad X_d^* = (I-A')^{-1}Y^*$$

where

X_d^* the entries in this column vector show the total amount of each industry's domestically produced output and a final entry reflecting the value of household services used in producing those outputs.

Y^* the entries in this column vector are the final demands for industry output including outputs of the households.

The national total requirements table is given by the expression $(I-A')^{-1}$. When a user chooses not to regionalize, the Port Kit defaults to this national total requirements matrix.

Each amount in the industry-by-industry total requirements table (a row value for a given column) is the amount of industry output necessary to deliver a dollar of an industry's output (the column industry) to final demand. This includes the dollar of direct requirements, plus the indirect requirements that are the result of interindustry purchases, and the induced output effects that result from the additional spending of households that are the a consequences of additional household earnings. The sum of the values of each column of the total requirement matrix is the column industry's total

output multiplier. For each dollar change in the final demand for the industry's output in an industry output, its corresponding column sum in the total requirements matrix is the total dollar change in the economy output that is the result of the initial dollar. Output multipliers for both the indirect and induced impacts are also found within the column sums for each industry.

Regionalization of the Direct Requirements Table

To regionalize the national I-O model, users have two options. They may adjust the model's technical coefficients to reflect regional industrial specialization, or they may alter the production function specification to reflect interindustry purchases within their study area.

A standard practice is to adjust the technical coefficients (the coefficients of the WB matrix in this case) with a regional purchase coefficient (RPC). The purpose of the RPC and the adjustment are to let technical coefficients better reflect regional trade flows. Misspecification of regional tradeflows is a major source of error in nonsurvey I-O models. Rose and Stevens (1990) warn of misspecification errors that can occur because of the openness of regional economies.[15] Chief among these problems is identifying the endogenous and exogenous components of income flow and expenditure flows within a region.

The Kit's RPCs are estimated by using a simple location quotient technique (LQ) derived from the user's input of regional and national employment and payroll data. This technique assumes that when a region is less specialized in an industry than the nation, it is less capable of satisfying regional demands than the nation's counterpart industry, and

[15] Rose, Adam and Benjamin Stevens. Transboundary Income and Expenditure Flows in Regional Input-Output Models. *Journal of Regional Science,* Vol. 31, No. 3, 1991, p 253-272.

therefore, the technical coefficient should be adjusted downward by a RPC (the product of the RPC and technical coefficient). In terms of a location quotients technique, when an industry within a study area has a LQ<1, the national technical coefficients are multiplied by industries LQ. When a LQ>1, the national technical coefficient is not altered. To compute the LQ, the model requires the user to input employment and payroll data at both the national and regional levels. In general, LQ's are computed using employment data as an example as

$$LQ_i = \frac{\frac{e_i}{\sum e_i}}{\frac{E_i}{\sum E_i}}$$

where

e_i is employment in regional industry i

$\sum e_i$ is total employment in the region

E_i is national employment in industry i

$\sum E_i$ is national employment

After the LQ computation and modifications to the technical coefficients, a new regionalized direct requirements table is constructed and a regional total requirements table computed**.**

Direct, Indirect, and Induced Output Effects

Once a total requirements table is built, the model is capable of computing the total output effect. In terms of the Kit, the total output effect is the change in the total

output in the study area that is a consequence of activities at the port or terminal. That is, the direct impacts calculated in the cargo flow, port users, and capital expenditures subroutines.

Letting DI represent a column vector whose elements are the direct impacts associated with a port or terminal activity, the total output effects (TO) are calculated as

$$(I-A')^{-1}*DIO = TO,$$

and for the i^{th} direct output effect (DIO_i) the total output effect (TO_i) is

$$(I-A')^{-1}*DIO_i = TO_i.$$

Once the total output effect is determined, the Kit computes the induced and indirect output effects. The computation of the induced output effects requires a slight modification to the employee compensation row of the total requirements matrix. The employee compensation paid for labor services to the households (the total requirements cell where the employee compensation row intersects the household column) is adjusted so that it only includes indirect and induced effects. The adjustment is accomplished by subtracting unity from the cell value. Once this modification is made, induced output effects are a straightforward computation.

Let EC_{ri} represent the i^{th} industry adjusted employee compensation row from the total requirements matrix. The induced output effect for the i^{th} industry ($INDUO_i$) is found by the following computation:

$$EC_{ri} *(TO_i-DIO_i) = INDUO_i,$$

where TO_i and DIO_i the i^{th} industry's total output effect and the direct output effect,

respectively. The total induced output (INDUO) effect is given by

$$INDUO = \sum INDUO_i.$$

The indirect output effects (INDIO) are found by multiplying the total requirements matrix less the EC_r row by the DIO vector and then subtracting the DIO from this product. An alternative method for the i^{th} industry is to find the indirect output effect ($INDIO_i$) by using the following definitional relationship

$$TO_i - DIO_i - INDUO_i = INDIO_i.$$

The total indirect output (INDIO) can then be determined by the following aggregation:

$$INDIO = \sum INDIO_i.$$

Direct, Indirect, Induced Income Impacts

Once the total output effects are calculated, they are used to compute the total income (TI) effect. This is accomplished by multiplying each industry's output effects by the appropriate EC_{ri} coefficient. For the i^{th} industry, the following calculations were made to compute the direct income effect (DIY_i), the indirect income effect ($INDIY_i$), the induced income effect ($INDUY_i$), and total income effect (TI_i):

$$EC_{ri} * DIO_i = DIY_i,$$

$$EC_{ri} * INDIO_i = INDIY_i,$$

$$EC_{ri} * INDUO_i = INDUY_i,$$

and

$$TI_i = DIY_i + INDIY_i + INDUY_i.$$

The total income effect for all industries is found by aggregating across the individual industries:

$$TI_i = \sum TI_i.$$

Employment Estimates

To estimate the employment impacts of port and terminal activities, the Kit uses 1992 national employment to output ratios. For the computation, the industry's output comes from the BEA's benchmark input-output accounts of the United States for 1992. The employment data for 1992 are taken from the Department of Labor, Covered Employment and Wage Program and County Business Patterns .[16] In estimating the employment impact for the i^{th} indusrty, the national employment output ratio for the industry (E/O_i) is calculated and then multiplied by the output effects to derive the employment impacts. In terms of the ith industry, the computaion equations are

$E/O_i * DIO_i = DIRE_i$, direct employ impact for industry i,

$E/O_i * INDIO_i = INDIE_i$, indirect employ impact for industry i

$E/O_i * INDUO_i = INDUE_i$, induced employ impact for industry I,

and

$DIRE_i + INDIE_i + INDUE_i = TEMPi$, total employment impact for industry i.

The total employment impact (TEMP) for all industries is found with the following equation:

$$TEMP = \sum TEMP_i .$$

Indirect Business Tax Estimates

Included in the Kit's databases, is an indirect business tax to employee compensation ratio for the inland waterways states. Given this ratio and an estimated change in level of employee compensation, estimates of the impacts of port and terminal

[16] Bureau of Labor Statistics', Covered Employment and Wages Program. U.S. Census Bureau, County Business Patterns, 1992.

activities on the study's area indirect business taxes are found by multiplying the two quantities together.

Let IBT be a state's indirect business tax to employee compensation ratio. The calculation formulas for estimating the impact on indirect business taxes are

$IBT * DIY_i = DIBTi$, direct indirect business tax effect for industry i,

$IBT * INDIO_i = INDIBT_i$, indirect busuiness tax effect for industry I,

$IBT_i * INDUO_i = INDBT_i$, induced business tax effect for industry i,

and

$TIBT_i = DIBT_i + INDIBT_i + INDBT_i$, total indirect business tax effect for industry i.

The total indirect business tax effect (TIBT) for all industries is found with the following equation:

$$TIBT = \sum TIBT_i.$$

APPENDIX 2

DETAILED PORT USER SURVEY

Name of firm: _____

Address:

_____

_____

_____

Please identify the type of industry your firm is associated with (for example: agriculture, manufacturing, construction, etc.; you may use an SIC code if you like)

_____

Do you use the Port of Little Rock to ship or receive products or inputs?

_____ Yes _____ No

What proportion, by value, are the products/inputs transit via the port?

Inputs _____%

Products _____%

List your top three customers:

	Name	Location (City)	Product
a.	_____	_____	_____
b.	_____	_____	_____
c.	_____	_____	_____

List your top three suppliers:

	Name	Location (City)	Product
a.	_____	_____	-_____
b.	_____	_____	-_____
c.	_____	_____	_____

For your operations in study area, please provide the data for your most recent year completed

Revenues: $_____

Employment: Full Time:_____ Part Time:_____

Estimate of percentage of employees living in Pulaski County: _____%

Total Payroll: $_____

Annual nonpayroll operating expenditures: $_____

Taxes Paid

State: $_____

Local: $_____

What percentage of your commodity flows (products and inputs) is dependent upon the following (Please total to 100%)

		List Your Top 3 Shipping Destinations		
Water	_____%	_____	_____	_____
Rail	_____%	_____	_____	_____
Truck	_____%	_____	_____	_____

Estimated number of out-of-town visitors who come to your firm yearly:
_____

Estimated amount of capital expenditures past five years

Expenditures on Structures: $_____
Square Footage:_____

Equipment: $_____
Percentage of equipment originating in Pulaski County _____%

Would you like to receive a copy of the findings of our study? _____

Respondent's Name: _____

Title: _____

Telephone: _____